Real-Time Meteorological Battlespace Characterization in Support of Sea Power 21

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LONG-TERM GOALS

This project is a coordinated effort with the Naval Strike and Air Warfare Center (NSAWC) and the Naval Pacific Meteorology and Oceanography (METOC) Detachment (NPMOD) at Naval Air Station (NAS) Fallon, NV to create a shore test and development site to demonstrate enhanced weather support for strike warfare using a combination of the Naval Research Laboratory (NRL) Coupled Ocean/Atmosphere Mesoscale Prediction System – On Scene (COAMPS-OS®) and NOWCAST capabilities. The NOWCAST system is capable of blending an ensemble of highly perishable, on-scene environmental data together in the context of operational situational awareness to provide a consistent, integrated, web-enabled picture of the current, near real-time METOC impacts both in the target area and within the battlegroup. This system will benefit the warfighter by providing a capability to help monitor and characterize the impact of rapidly changing, operationally significant weather situations that can be accessed directly over the Global Information Grid (GIG) by decision makers whenever they need to evaluate their missions for environmental dependencies within a common situational awareness framework. This commonality should help to improve coordination and efficiency on the battlefield.

OBJECTIVES

The specific objectives of this project are 1) to implement a combined COAMPS-OS and NOWCAST system in support of NAS Fallon; 2) to demonstrate enhanced real-time wind analysis capabilities by incorporating Through-The-Sensor (TTS) radar and Unmanned Aerial Vehicle (UAV) collected target area environmental data using data fusion and assimilation capabilities under development at NRL and, when available, *Distributed Collaborative Adaptive Sensing* (DCAS) technology developed by a National Science Foundation (NSF) funded project at the University of Oklahoma (OU); and 3) to demonstrate the Rapid Environmental Assessment (REA) capability using the Supplemental Weather Radar (SWR) and UAV assets at Fallon, NV in coordination with NPMOD Fallon and with the cooperation of the Fleet Numerical Meteorology and Oceanography Center (FNMOC).

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14. ABSTRACT

This project is a coordinated effort with the Naval Strike and Air Warfare Center (NSAWC) and the Naval Pacific Meteorology and Oceanography (METOC) Detachment (NPMOD) at Naval Air Station (NAS) Fallon, NV to create a shore test and development site to demonstrate enhanced weather support for strike warfare using a combination of the Naval Research Laboratory (NRL) Coupled Ocean/Atmosphere Mesoscale Prediction System ? On Scene (COAMPS-OS?) and NOWCAST capabilities. The NOWCAST system is capable of blending an ensemble of highly perishable on-scene environmental data together in the context of operational situational awareness to provide a consistent, integrated, web-enabled picture of the current, near real-time METOC impacts both in the target area and within the battlegroup. This system will benefit the warfighter by providing a capability to help monitor and characterize the impact of rapidly changing, operationally significant weather situations that can be accessed directly over the Global Information Grid (GIG) by decision makers whenever they need to evaluate their missions for environmental dependencies within a common situational awareness framework. This commonality should help to improve coordination and efficiency on the battlefield.

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The three-year demonstration (FY04 - FY06) of real-time NOWCAST and forecast products for Fallon will provide additional support to NPMOD Fallon for Strike Warfare (STW) training. Warfighter (pilots, squadron commanders, air traffic control specialists, STW planners, and operational METOC specialists) comments in a focused Integrated Product Team (IPT) will provide valuable feedback to improve the system; verification and validation data collected will help to scientifically evaluate the value added by NOWCAST to traditional human-intensive STW forecasting techniques.

APPROACH

We will integrate COAMPS-OS and NOWCAST into a single computer system and install the system at NRL Monterey with network access provided to NPMOD Fallon in a reach-back mode of operation. Products from the combined system will be available over the network where they will be interfaced with NSAWC training operations through weather briefs provided by NPMOD Fallon. Although NSAWC is located at Fallon in large part because of the high percentage of "good days for flying" weather, the area does experience hazardous and challenging weather with winter storms and related flight icing conditions, occasional summer thunderstorms, and ceiling and visibility restrictions, including blowing dust, which varies valley-to-valley. In spite of the good weather, we will test NOWCAST where the warfighter trains, as a way of exposing a capability that eventually may be found operationally. We will work with NPMOD Fallon and NSAWC to "fine tune" NOWCAST development while introducing warfighters to advanced R&D capabilities and collecting their feedback via the IPT process. The IPT will consist of meteorologists and warfighters from elements of NSAWC and will meet annually with the goals of providing detailed evaluation of products, following improvements during the tests, and ensuring products are indeed useful. A variety of means will be employed to measure value, including a structured post-mission debrief, in a continuous effort to "fine-tune" product quality in addition to the more standard statistical measures provided by the analysis innovations. The debrief methodology affords immediate and accurate feedback as to whether information and products provided by NOWCAST were helpful and accurate, and what may be desired that was not provided.

In order to provide data for the system, an operational Tactical Environmental Database System (TEDS) database will be installed with a data feed of model grids and conventional observations from FNMOC. A data interface will be developed for the local Supplemental Weather Radar (SWR), an Enterprise Inc. Doppler weather radar implemented by SPAWAR. The local SWR data will be combined with NOAA Next Generation Weather Radar (NEXRAD) data available from the Reno and other nearby NEXRAD radars. The SIPRNET implementation at NRL requires SIPRNET connectivity with the Navy Marine Corps Internet (NMCI) at Fallon. A certified unclassified-to-classified Network Pump data transfer capability will be implemented by NRL to automatically move the radar data to the SIPRNET; FNMOC can provide grids and observations by SIPRNET today.

To supplement the data provided by FNMOC and the radar data, we plan to utilize the Desert Research Institute (DRI), Reno, NV to purchase and install a small local range sensor network to upgrade the capabilities at NPMOD Fallon to provide automated surface observations for verification of NOWCAST products. Four surface sensor suites will be set up to focus on the NSAWC training ranges where complex terrain influences the wind flow and mesoscale variations in thunderstorms and winter storms make accurate forecasting and assessment of the "weather on target" difficult. The additional surface data provided by the surface sensor network will provide the valuable data critical to making such an assessment.

In addition to the NSAWC component, we plan to develop and demonstrate a real-time interface to the SPS-48 radar and determine its value added to the TTS data suite for wind and hazardous weather products produced by NOWCAST. SPAWAR is developing the Doppler weather radar capability for the SPS-48 radar onboard all carriers. We envision that this project will be ready in the out-years to provide data for NOWCAST. Additionally, as capability becomes available, we also plan to leverage the ONR supported National Weather Radar Testbed (NWRT) and the large NSF DCAS development project with our partners at OU to develop the capability to provide high-resolution 3D wind data from the ground to 3 km altitude. These data will be fused to provide continuous winds for chemical/biological dispersion models.

WORK COMPLETED

A Linux cluster computer system was provided by NRL and both COAMPS-OS and NOWCAST have been installed, integrated, tested and are currently running on the system in a dedicated domain encompassing the Fallon range area. In addition to the cluster, computers were provided by NRL to host the TEDS database and to handle the satellite and radar data processing. These systems have been implemented on the Internet and once issues with the Network Pump transfer of radar, satellite, and lightning data to the SIPRNET are worked out and the systems accredited for classified operations, the systems will be moved to the SIPRNET. In coordination with NPMOD Fallon, specific domains have been set up and are running for both COAMPS® and NOWCAST. As shown in Figure 1, geographic overlays for the specific ranges at Fallon have been added to the system for enhanced displays and the software and connectivity has been tested with NMCI terminals at Fallon.

In coordination with the ONR NOWCAST development project (N0001405WX20413), the ONR Shipboard Data Assimilation System development project (N0001405WR20187), and the NRL Base Optimum Use of DoD Radar in Battlespace Environmental Prediction project, many advancements in radar data processing have been applied to the Fallon system. Software was developed and integrated with NOWCAST to receive and process the SWR data from Fallon. A radar level-III data mosaic creation system has been established for the Fallon area to provide real-time 2-D radar mosaic data sets for simple storm detection and tracking using a combination of SWR and NEXRAD data. The 3.5-Dimensional Variational Radar Wind Analysis System (3.5DVar) has been implemented for real-time runs for the Fallon area to provide 3-dimensional winds from multiple radar observations. The NRL 3-D radar mosaic has been implemented for the Fallon area to provide real-time, 3-D level-II radar reflectivity data for the National Center for Atmospheric Research (NCAR) Thunderstorm Identification, Tracking, Analysis and Nowcasting (TITAN) algorithm which has been adapted to run locally within our NOWCAST data processing environment.

DRI has procured, performed the site engineering, and has partially completed installation of a small network of surface sensors to collect validation data for NOWCAST over the Fallon range complex. In coordination with NPMOD Fallon, data collection sites were identified at Bravo 19, Bravo 20, the Centroid, and the Electronic Warfare Complex. These data will be integrated into a broader meteorological database for Nevada managed by DRI and made available to NRL. Software was also developed that downloads Automated Weather Station (AWS) and MesoWest observations in real-time from the Internet and displays the observations in NOWCAST. NOWCAST was also enhanced to display aircraft, including Unmanned Aerial System (UAS), meteorological observations collected in flight. UAS data are increasingly available from training flights.

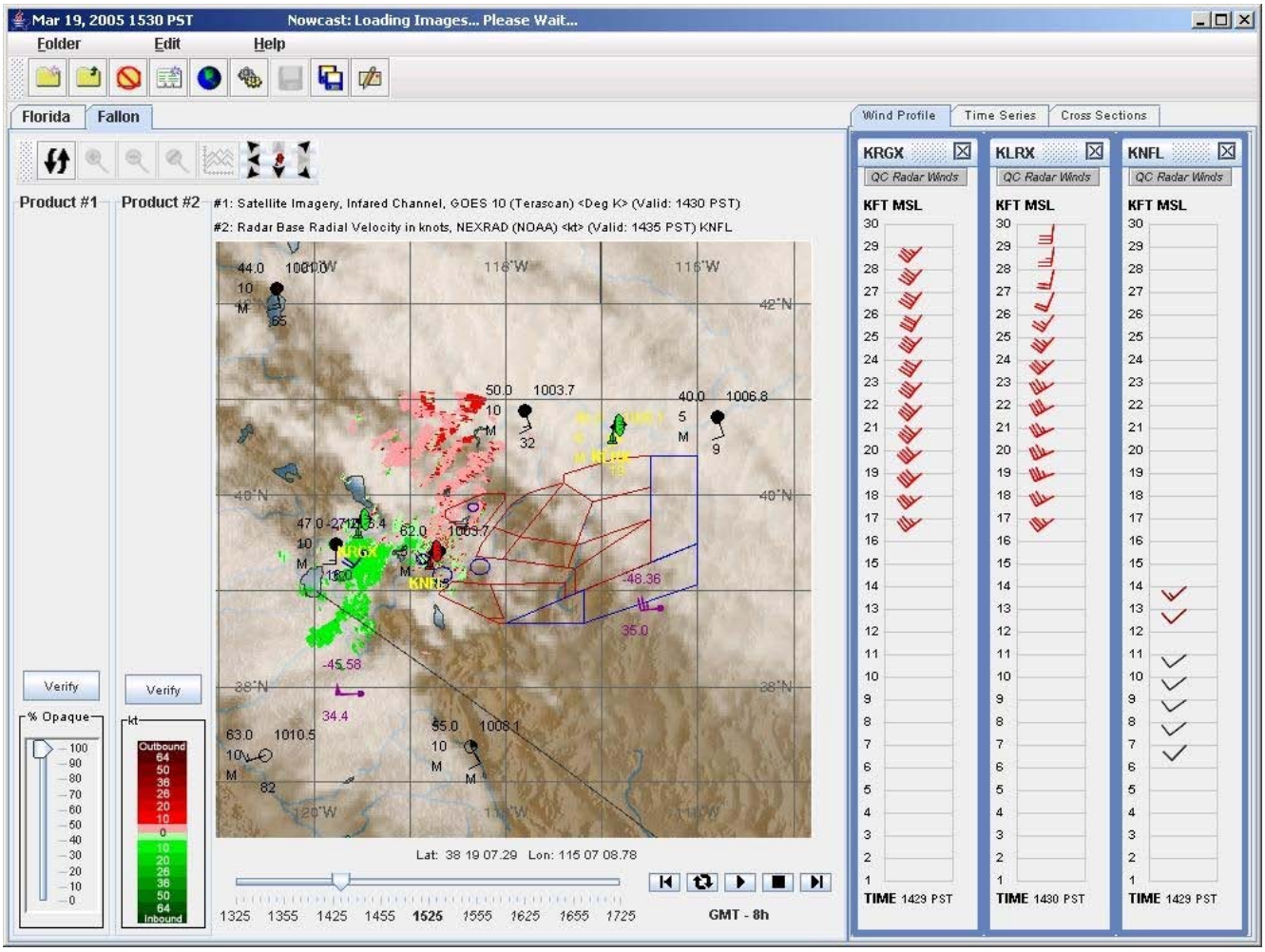

Figure 1. The NOWCAST user interface showing a map of the Fallon operational areas, single station radial velocity radar data, satellite data, METAR surface station observations (black), and aircraft observations (colored by altitude); the three panels on the right show the concurrent radar wind profiles from the Fallon SWR and Reno and Elko NEXRADs.

Several new products have been added to improve the Fallon NOWCAST system. Based on user feedback, we developed a Geographic Information System (GIS) standards-based thin client version of the NOWCAST application. This approach lets us test the interoperability between NOWCAST and Command and Control applications provided by the standardized GIS environment selected for future Navy applications development. The new client interface does not require any software to be loaded on the client computer and supports nearly all the NOWCAST features using a standardized web services approach. In addition, based on tests with the USS NIMITZ, we developed a suite of "lite" products that consist of scripted NOWCAST animated products automatically produced and accessible over the web. Although these products are not user-configurable, they are easier to access via IT-21 and can easily be incorporated into PowerPoint briefs. Software has also been developed and added to COAMPS-OS to be able to produce heat index and aircraft icing forecast products. These products will be shared between COAMPS-OS and NOWCAST.

New METOC user capabilities have been added to the NOWCAST system so that the NOWCAST administrator can easily manage user accounts for the Fallon users. Several trips have been made to Fallon for coordination and training on the system. Our effort at validation has also been coordinated with the research effort to develop METOC Metrics at the Naval Postgraduate School (NPS).

RESULTS

The Fallon COAMPS-OS/NOWCAST system fuses a wide variety of data types. Radar data has been assimilated into high resolution wind products that provide impacts for aircraft operations. The interaction with the warfighters has reinforced their priorities for data fusion and decision-enabling products and has resulted in several new product lines and interfaces. Through direct interaction with NPMOD Fallon, we find a continuing need for NOWCAST to supplement existing METOC forecast assets with an automated capability to continuously assimilate, fuse, and display data from all sources including conventional surface observations, satellite, radar, and "through-the-sensor" observations. A new product class was requested for NOWCAST to provide low-level cross sections of ceiling, visibility, and winds on training routes from Fallon to various locations on the West Coast and these products are in development. We expect that as the verification data becomes available in the near future that the quantitative assessment of NOCAST products will come to fruition.

IMPACT/APPLICATIONS

The technology being implemented and tested at Fallon is the focus of a telescoping strategy to provide automated environmental products tailored to the decision-making needs of the warfighter, from global scales down to tactical scales in both time and space, within the emerging Command and Control framework of the Global Information Grid (GIG). In particular, NOWCAST represents a paradigm shift from periodic products that are briefed and interpreted by METOC personnel to nearly continuous products that are easily accessible over the web, automatically updated, and tailored for interpretation directly by the warfighter. NOWCAST enhances the role of METOC support by supplementing the existing forecast capability with continuous, automated, short-term (less than 2 hours) decision-enabling products, thus freeing the forecaster to concentrate on the longer-range projections for planning and evaluation purposes.

RELATED PROJECTS

This RTP has a companion 6.4 project supported by the Oceanographer of the Navy (N7C) (PE 0603207N X2342). In addition to the ONR projects for Shipboard Data Assimilation System development (N0001405WR20187) and NOWCAST development (N001405WX20413), the NRL Base Optimum Use of DoD Radar in Battlespace Environmental Prediction project, and a similar SPAWAR Systems Center project using the SPS-48 radar are important to NOWCAST. The National Weather Radar Testbed (NWRT) at the National Severe Storms Laboratory (NSSL) will be a critical source of radar data processing and quality control technology. Automated chemical and biological dispersion technology has been adapted to NOWCAST under Defense Threat Reduction Agency (DTRA) sponsorship.

PUBLICATIONS

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